

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1. (Previously Presented) A computer-implemented brain current source estimating method for estimating, based on an electromagnetic field observed outside a scalp, a position of a current source as a source of said electromagnetic field existing in a brain, comprising the steps of

receiving measurements of an observed electromagnetic field observed outside a scalp;

setting, in a computer simulation of the brain, a plurality of computer simulated curved surfaces having depths from brain surface different from each other and shapes not intersecting with each other, and setting lattice points on each of said computer simulated curved surfaces;

automatically estimating, on each of said computer simulated curved surfaces, a current distribution for recovering said observed electromagnetic field, wherein said step of automatically estimating a current distribution includes a step of setting, when said current distribution is estimated in accordance with variational Bayesian estimation, a hierarchical prior distribution representing a localized condition of said current source in said variational Bayesian estimation;

based on an expansion of the current distribution estimated on each one of said computer simulated curved surfaces and a difference between an electromagnetic field recovered based on said current distribution and said observed electromagnetic field, identifying one computer simulated curved surface among said plurality of computer simulated curved surfaces as a true curved surface on which said current source exists, so that said expansion and said difference attain relative minimums at said identified computer simulated curved surface; and

outputting a position corresponding to said identified computer simulated curved surface as the position of said current source, wherein

the above steps are performed by one or more computers programmed to perform the above steps.

2. (Previously Presented) The brain current source estimating method according to claim 1, wherein

said step of automatically estimating said current distribution includes the step of determining posterior probability by Bayesian estimation method from prior distribution and observation data of said electromagnetic field; and

said step of identifying as a true curved surface on which said current source exists includes the step of

identifying a computer simulated curved surface of which corresponding said posterior probability attains the maximum, among said computer simulated curved surfaces.

3. (Previously Presented) The brain current source estimating method according to claim 2, wherein

said step of automatically estimating a current distribution includes the step of identifying a first computer simulated curved surface closest to said brain surface and having posterior probability attaining a relative maximum, among said plurality of computer simulated surfaces, while successively moving from a computer simulated curved surface on the side of the brain surface to a deeper side; and

said step of identifying a curved surface as a true curved surface on which said current source exists includes the steps of

identifying a localized current distribution corresponding to a point of relative maximum of said current distribution, on said first computer simulated curved surface,

separating a plurality of local surfaces each including said localized current distribution, and

fixing, among said plurality of local surfaces, local surfaces other than a local surface as an object of identification, moving said local surface as an object of identification in the depth direction, and identifying positions where said posterior probability attains the relative maximum, successively from the side closer to said brain surface.

4. (Previously Presented) The brain current source estimating method according to claim 3, wherein

in said step of automatically estimating a current distribution, said current distribution is estimated with a first spatial resolution;

said method further comprising the step of

re-estimating said current distribution with a second spatial resolution higher than said first resolution and resolution of said plurality of computer simulated curved surfaces in the depth direction being improved.

5. (Previously Presented) The brain current source estimating method according to claim 1, wherein

said step of setting a hierarchical prior distribution includes the step of
setting the hierarchical prior distribution using observation data obtained by other observation method independent of said observation of electromagnetic field for said estimation of the current source.

6 – 10. (Canceled)

11. (Previously Presented) A brain current source estimating apparatus for estimating, based on an electromagnetic field observed outside a scalp, a position of a current source as a source of said electromagnetic field existing in a brain, comprising:

measurement receiving means for receiving measurements of an observed electromagnetic field observed outside a scalp;

computer simulated curved surface setting means for setting, in a computer simulation of the brain, a plurality of computer simulated curved surfaces having depths from brain surface different from each other and shapes not intersecting with each other, and setting lattice points on each of said computer simulated curved surfaces;

current distribution estimating means for automatically estimating, on each of said computer simulated curved surfaces, a current distribution for recovering said observed electromagnetic field, wherein

said current distribution estimating means includes condition setting means for setting, when said current distribution is estimated in accordance with variational Bayesian estimation, a

hierarchical prior distribution representing a localized condition of said current source in said variational Bayesian estimation; and

current source identifying means for selectively identifying, based on an expansion of the current distribution estimated on each one of said computer simulated curved surfaces and a difference between an electromagnetic field recovered based on said current distribution and said observed electromagnetic field, one computer simulated curved surface among said plurality of computer simulated curved surfaces as a true curved surface on which said current source exists, so that said expansion and said difference attain relative minimums at said identified computer simulated curved surface.

12. (Previously Presented) The brain current source estimating apparatus according to claim 11, wherein

said automatic current distribution estimating means includes

posterior probability determining means for determining posterior probability by Bayesian estimation method from prior distribution and observation data of said electromagnetic field; and

said current source identifying means includes

computer simulated curved surface identifying means for identifying a computer simulated curved surface of which corresponding said posterior probability attains the maximum, among said computer simulated curved surfaces.

13. (Previously Presented) The brain current source estimating apparatus according to claim 12, wherein

said automatic current distribution estimating means includes

shallowest computer simulated curved surface identifying means for identifying a first computer simulated curved surface closest to said brain surface and having posterior probability attaining a relative maximum, among said plurality of computer simulated surfaces, while successively moving from a computer simulated curved surface on the side of the brain surface to a deeper side; and

said current source identifying means includes

localized current distribution identifying means for identifying a localized current distribution corresponding to a point of relative maximum of said current distribution, on said first computer simulated curved surface,

local surface extracting means for separating a plurality of local surfaces each including said localized current distribution, and

local surface position identifying means for fixing, among said plurality of local surfaces, local surfaces other than a local surface serving as an object of identification, moving said local surface as an object of identification in the depth direction, and identifying positions where said posterior probability attains the relative maximum, successively from the side closer to said brain surface.

14. (Previously Presented) The brain current source estimating apparatus according to claim 13, wherein

said automatic current distribution estimating means estimates said current distribution with a first spatial resolution and thereafter re-estimates said current distribution with a second spatial resolution higher than said first resolution and resolution of said plurality of computer simulated curved surfaces in the depth direction being improved.

15. (Previously Presented) The brain current source estimating apparatus according to claim 11, wherein

said condition setting means sets the hierarchical prior distribution using observation data obtained by other observation method independent of said observation of electromagnetic field for said estimation of the current source.

16. (Currently Amended) A computer readable storage medium storing program code for causing a computer to estimate, based on an electromagnetic field observed outside a scalp, a position of a current source as a source of said electromagnetic field existing in a brain, the program code causing the computer to perform a method comprising the steps of:

receiving measurements of an observed electromagnetic field observed outside a scalp;

setting, in a computer simulation of the brain, a plurality of computer simulated curved surfaces having depths from brain surface different from each other and shapes not intersecting with each other, and setting lattice points on each of said computer simulated curved surfaces;

automatically estimating, on each of said computer simulated curved surfaces, a current distribution for recovering said observed electromagnetic field, wherein

said step of automatically estimating a current distribution includes a step of setting, when said current distribution is estimated in accordance with variational Bayesian estimation, a hierarchical prior distribution representing a localized condition of said current source in said variational Bayesian estimation;

based on an expansion of the current distribution estimated on each one of said computer simulated curved surfaces and a difference between an electromagnetic field recovered based on said current distribution and said observed electromagnetic field, selectively identifying one computer simulated curved surface among said plurality of computer simulated curved surfaces as a true curved surface on which said current source exists, so that said expansion and said difference attain relative minimums at said identified computer simulated curved surface; and

outputting a position corresponding to said identified computer simulated curved surface as the position of said current source[[, wherein]].

17. (Previously Presented) The computer readable storage medium according to claim 16, wherein

said step of automatically estimating said current distribution includes the step of determining posterior probability by Bayesian estimation method from prior distribution and observation data of said electromagnetic field; and

said step of identifying as a true curved surface on which said current source exists includes the step of

identifying a computer simulated curved surface of which corresponding said posterior probability attains the maximum, among said computer simulated curved surfaces.

18. (Previously Presented) The computer readable storage medium according to claim 17, wherein

said step of automatically estimating a current distribution includes the step of

identifying a first computer simulated curved surface closest to said brain surface and having posterior probability attaining a relative maximum, among said plurality of computer simulated surfaces, while successively moving from a computer simulated curved surface on the side of the brain surface to a deeper side; and

said step of identifying a curved surface as a true curved surface on which said current source exists includes the steps of

identifying a localized current distribution corresponding to a point of relative maximum of said current distribution, on said first computer simulated curved surface,

separating a plurality of local surfaces each including said localized current distribution, and

fixing, among said plurality of local surfaces, local surfaces other than a local surface serving as an object of identification, moving said local surface as an object of identification in the depth direction, and identifying positions where said posterior probability attains the relative maximum, successively from the side closer to said brain surface.

19. (Previously Presented) The computer readable storage medium according to claim 18, wherein

in said step of automatically estimating a current distribution, said current distribution is estimated with a first spatial resolution;

said method further comprising the step of

re-estimating said current distribution with a second spatial resolution higher than said first resolution and resolution of said plurality of computer simulated curved surfaces in the depth direction being improved.

20. (Previously Presented) The computer readable storage medium according to claim 16, wherein

said step of setting a hierarchical prior includes the step of

setting the hierarchical prior distribution using observation data obtained by other observation method independent of said observation of electromagnetic field for said estimation of the current source.